resistance in the horn type was very detrimental, that the electrolytic type was very efficient, but that its expense limited its use, and that the multigap type was an efficient and cheap type of lightning arrester.

MESSRS. LONGMANS AND CO. have in the press "Modern Practice in Heat Engines," by T. Petrie, which is intended to form a companion to the late W. Inchley's "Theory of Heat Engines." It deals with the subject of power from heat engines as a whole, and attempts to show how far theory may be applied to the design of modern types. The book is divided into three sections, steam boilers, steam prime movers, and internal-combustion engines, each section containing a descriptive chapter on the latest types with sectional illustrations which, in many cases, approximate to working drawings. Another book announced by the same publishers is a translation, by Dr. J. S. Thomas, of Prof. A. Smits's "The Theory of Allotropy."

MR. F. EDWARDS, 83 High Street, Marylebone, W.1, has just issued a Hand-list (No. 422) of Biographies, Autobiographies, Diaries, Journals, Correspondence, etc., of Famous Men and Women. Many men of science are represented in the catalogue.

MR. E. MARSDEN, one of the authors of "Geography for Junior Classes," of which a short notice appeared in NATURE of December 22 last, writes to point out that the phrase "lines and belts of equal heat," which the reviewer remarked "is bad anywhere," occurs also in Geikie's "Elementary Lessons in Physical Geography" and in the revised edition of Huxley's "Physiography." The use of the phrase in other books does not, however, alter the reviewer's objection to it.

IN an article entitled "Fisheries Biology" in NATURE of December 29, p. 585, it is stated that "the spur-dog and nurse-hound are viviparous." Mr. E. Ford writes to inform us that the term "nurse-hound" is applied at Plymouth to *Scyliorhinus stellaris*, which is not viviparous. We understand from the writer of our article that confusion has arisen from the fact that the name "nurse-hound" is also used by fishermen in his district to refer to *Mustelus vulgaris*, which is viviparous.

Our Astronomical Column.

THE SHOWER OF JANUARY METEORS.—A rather abundant display of these objects was observed on the night following January 3. Mr. W. F. Denning writes as follows:—At Bristol the early part of the evening was clear, and between 5.40 and 6.50 p.m. meteors appeared at the rate of thirty per hour. Clouds, wind, and sleet then interrupted watching until about 9 p.m., when the atmosphere again cleared, and the remainder of the night was splendidly favourable for observation. The shower, however, declined in numbers strikingly, for in the two or three hours preceding midnight the hourly rate of apparition was only twelve, and there was a further falling off as the night progressed. The radiant point was at 232°+53°. Large meteors were frequent, and a number of them have been recorded at several stations. Miss A. Grace Cook witnessed the event from Stowmarket and saw a considerable number of meteors on the two nights January 2 and 3. She registered a fair proportion of large ones, and found the maximum intensity occurred in the early part of January 3. The radiant was at 231°+53°.

SPECTRAL EVIDENCE OF A PERSISTENT AURORA.—Bulletin No. 76 (vol. 3, No. 1) of the Lowell Observatory, contains an interesting account by Mr. V. M. Slipher of his successful attempts to show that the aurora is always present in the night sky. Working on the fact that the spectrum of the aurora consists of certain emissions, of which one in the yellow-green is so intense relatively as to contain a considerable portion of the total auroral light, he finds it possible to record this line with an exposure of only a few hours, even if there be moonlight. The instrument he employs is a spectrograph with a 66 degree flint glass prism, and a Dallmeyer lens of f/1·9 ratio, the photographic plates being of the Cramer isochromatic brand. This spectrograph was usually simply pointed to the sky, but in some cases a small objective was placed in front of it. All the exposures he made showed the characteristic auroral line, thus proving the existence of auroral illumination, persistent or permanent at least over the period covered by his series of plates, which commenced in the year 1915. The two plates which accompany his paper show the auroral line clearly on both moonlight and moonless nights.

MOVEMENTS IN SPIRAL NEBULÆ.—Dr. Jeans exhibited at the November meeting of the Royal Astronomical Society some slides sent by Dr. Van Maanen, showing movements in the spirals M 101 and M 33. He demonstrated that the only tenable motions that would conserve the equiangular spiral forms were compounded of pure rotation and motion along the arms. The latter type greatly predominates in these nebulæ, and the indicated times of revolution round the nucleus are 85,000 years and 160,000 years respectively. Since only two whorls of nebulosity can be traced, implying a duration of a third of a million years, it was conjectured that the outer whorls may have become invisible, just as the puffs of steam from a locomotive soon dissipate. By the combination of observed shifts with line-of-sight velocities, a distance of 2000 parsecs was deduced for M 33. This would be fatal to the island-universe hypothesis, since it would place the object well within the confines of the galaxy. There have been fairly regular oscillations of opinion on the hypothesis, the prevailing view at the Royal Astronomical Society's meeting being hostile to it.

A BRIGHT FIREBALL.—Mr. G. E. Sutcliffe writes from Shahpur, Ahmedabad, India, that on November 22 last, at about 6 a.m., when gazing towards the Southern Cross, he saw a large fireball emerging from the horizon. The object appeared to be approaching him and to move more slowly than ordinary shooting stars. It became intensely brilliant. Its motion was directed nearly from south to north, and it passed a little to the east of his zenith. During the early part of its track the fireball was globular in shape, and it had a distinct tail like a comet.

in atomic weight amounted in different experiments to from slightly less than to considerably more than one part in a thousand. A considerable amount of the isotopic acid has been produced. These experiments seem to confirm beyond doubt the existence of the isotopes of chlorine first announced by Dr. Aston on the basis of positive-ray analysis. The latter method gives, in addition, the atomic weights of the two isotopes.

MESSRS. BENN BROS., LTD., announce for publication in March a work which should be of interest and value to many readers, viz. "The Early Ceramic Wares of China," by A. L. Hetherington, in which will be described the main characteristics of the products of the Chinese factories before 1368. The same publishers also promise a new series entitled "The Chemical Engineering Library," the first nine volumes of which will be The General Principles of Chemical Engineering Design; The Layout of Chemical Works, H. Griffiths; Materials of Construction: I., Non-Metals, H. Griffiths; Materials of Construction: II., Metals, H. Griffiths; Mechanical Handling, A. Reid; Weighing and Measuring Chemical Products, Malan and Robinson; Flow of Liquid Chemicals in Pipes, N. Swindin; Chemical Works Pumping, N. Swindin; and Factory Wastes as Fuels, A. Reid.

MESSRS. H. K. LEWIS AND CO., LTD., 136 Gower Street, London, have just issued an up-to-date list of "College Text-books and Works of Reference in Science and Technology." The titles are arranged under authors' names, and are classified under eighteen subjects, some of which, such as chemistry, engineering, etc., are again divided. The subjects are arranged alphabetically, whilst a contents-list on the first pages makes reference to any subject quick and easy. The list will be sent post free to any address on application.

Our Astronomical Column.

DEDUCTION OF STAR-DISTANCES FROM PROPER MOTIONS.—The proper motions are almost our sole guides in estimating the distances of the more remote stars. Hence any method that affords a check on the results is of value. Prof. H. N. Russell points out in the *Astrophysical Journal* for September last that we can estimate the distance either (1) by correlating the motion away from the solar apex with the sun's velocity, or (2) by correlating the cross-motion with the line-of-sight velocity. As a test he has divided the 180 stars of type B_8 to B_5, the radial velocities of which were found by Campbell, into eighteen groups, the mean position of each group being nearly the same. He finds for the general mean parallax 0·0083″ from (1) and 0·0058″ from (2). One reason given for the smaller value from method (2) is that some of the stars may be undetected spectroscopic binaries, in which case the adopted line-of-sight velocity is presumably too great. The probable error of result (1) is 0·0010″, of (2) 0·0014″. In general, method (1) gives the best results for objects of small average velocity like the B stars, while (2) is better for quick movers like the planetary nebulæ. The apparent close connection between period and absolute magnitude in the Cepheid variables was originally deduced from results obtained by method (1), and later obtained considerable confirmation from a study of the variables in the globular clusters, which appear to be mainly Cepheids.

METEORIC SHOWER OF DECEMBER 4–5, 1921.—Mr. W. F. Denning writes that he has received a communication from the Tokyo Astronomical Observatory, Japan, stating that an abundant display of meteors was observed there on the morning of December 5. Watching 55 minutes between 4.15 and 5.10 G.S.T. of Japan (December 4 between 7.15 and 8.10 G.M.T.), Mr. S. Inouye saw fifty or sixty meteors, and recorded the paths of forty-six meteors, among which forty-four radiated from about 156°+37° near β Leonis Minoris. The meteors were rather rapid, and the magnitudes ranged nearly from 2·0 to 4·5.

On the next morning Mr. Inouye watched 15 minutes, but no meteors belonging to the same radiant were observed.

Mr. S. Kanda calculated the following elements from the above radiant point, assuming the orbit to be parabolic:

$$\Omega = 252{\cdot}1^\circ,\ w = 232{\cdot}6^\circ,\ i = 133{\cdot}3^\circ,\ q = 0{\cdot}791.$$

No comet is identified with these elements.

Mr. Denning adds that this shower in Leo Minor was well observed at Bristol on November 25–28, 1876, when he observed 26 meteors from the point 155°+36°. The observation was reported in NATURE of December 21, 1876, p. 158. The shower was also seen by him on December 2, 5, 7, and 10, 1885, when the radiant point was redetermined at 152°+40°.

The display witnessed at Tokyo on the night following December 4 last could scarcely have been well observed in England, for when the maximum occurred at 7.35 p.m. G.M.T. the radiant point was close to the north-north-east horizon, whereas at Tokyo it was situated only a few degrees east of the zenith, and splendidly placed for the abundant distribution of its meteors.

POPULAR ASTRONOMY IN SWEDEN.—The Stockholm periodical *Populär Astronomisk Tidskrift* continues to produce articles of much interest and practical value. Häfte 3 and 4, 1921, contain a useful illustrated article by Edv. Jäderin on the graphical prediction of eclipses and occultations. The methods are easy to follow and capable of an accuracy that is amply sufficient.

O. A. Åkesson discusses the periodicity and motion of sun-spots. The daily amounts of rotation for different latitudes are plotted for the two periods 1886–97 and 1898–1909. The values for the second period show a diminution of nearly 1 per cent. compared with the former. H. v. Zeipel contributes a study of the cluster M 37, near θ Aurigæ. He finds the colour-indices by comparison of photographic with photo-visual magnitudes, and deduces a distance of 1500 parsecs. There is also an illustrated article on the Babelsberg Observatory and its new refractor (aperture 65 cm.) and reflector (aperture 120 cm.), both made by Zeiss.

The approaching series of occultations of Aldebaran are the subject of a useful note. Accurate observations of the bright-limb phases of these phenomena will serve to test the conjecture that there may be a sensible atmosphere on the moon's sunlit face.

February 21. The chair will be taken at 3 p.m. by the Duchess of Portland, and an address on the work of the society will be delivered by Viscount Grey of Fallodon.

AT the annual general meeting of the Royal Meteorological Society on January 18 the following officers were elected:—*President:* Dr. C. Chree. *Vice-Presidents:* Mr. C. L. Brook, Mr. W. W. Bryant, Mr. R. H. Hooker, and Dr. E. M. Wedderburn. *Treasurer:* Mr. W. Vaux Graham. *Secretaries:* Mr. J. S. Dines, Mr. L. F. Richardson, and Mr. Gilbert Thomson. *Foreign Secretary:* Mr. R. G. K. Lempfert. *Council:* Dr. J. Brownlee, Mr. D. Brunt, Mr. C. J. P. Cave, Mr. J. E. Clark, Mr. R. Corless, Mr. Francis Druce, Mr. J. Fairgrieve, Col. H. G. Lyons, Mr. Henry Mellish, Sir Napier Shaw, Dr. G. C. Simpson, and Mr. F. J. W. Whipple. Communications should be addressed to the secretaries at 49 Cromwell Road, South Kensington, S.W.7.

THE following officers and members of council of the Royal Astronomical Society were elected at the anniversary meeting on February 10:—*President:* Prof. A. S. Eddington. *Vice-Presidents:* Dr. J. L. E. Dreyer, Sir F. W. Dyson, Prof. A. Fowler, and Prof. H. F. Newall. *Treasurer:* Col. E. H. Grove-Hills. *Secretaries:* Dr. A. C. D. Crommelin and the Rev. T. E. R. Phillips. *Foreign Secretary:* Prof. H. H. Turner. *Council:* Prof. A. E. Conrady, Dr. J. W. L. Glaisher, Mr. P. H. Hepburn, Mr. J. Jackson, Dr. H. Jeffreys, Prof. F. A. Lindemann, Dr. W. H. Maw, Prof. T. R. Merton, Prof. J. W. Nicholson, Mr. J. H. Reynolds, Lt.-Col. F. J. M. Stratton, and Mr. H. Thomson.

THE annual general meeting of the Physical Society of London was held on February 10, and the following officers and members of council were elected:—*President:* Dr. A. Russell. *Vice-Presidents:* Lord Rayleigh, Prof. T. Mather, Mr. T. Smith, and Prof. G. W. O. Howe. *Secretaries:* Mr. F. E. Smith, "Redcot," St. James's Avenue, Hampton Hill, and Dr. D. Owen, 62 Wellington Road, Enfield. *Foreign Secretary:* Sir Arthur Schuster. *Treasurer:* Mr. W. R. Cooper. *Librarian:* Dr. A. O. Rankine. *Other Members of Council:* Mr. C. R. Darling, Prof. C. L. Fortescue, Dr. E. Griffiths, Dr. E. H. Rayner, Mr. J. H. Brinkworth, Mr. J. Guild, Dr. F. L. Hopwood, Dr. E. A. Owen, Dr. J. H. Vincent, and Dr. G. B. Bryan.

A TRANSLATION of the Nobel Prize address delivered by Prof. Max Planck before the Royal Swedish Academy of Sciences on "The Origin and Development of the Quantum Theory" will be published at an early date by the Oxford University Press.

READERS in search of book bargains should see Catalogue No. 454 of Messrs. William Glaisher, Ltd., 265 High Holborn, W.C.1, and Catalogue No. 424 of Mr. F. Edwards, 83 High Street, Marylebone, W.1, in which are to be found the titles of many science books offered at greatly reduced prices. The works in the first-named list are publishers' remainders; those in Mr. Edwards's are second-hand.

Our Astronomical Column.

FIREBALL OBSERVED IN SUNSHINE.—Mr. W. F. Denning writes that on February 7, at 3.55 p.m., he observed a brilliant fireball descending in the northern sky. The sun was shining at the time, and the firmament was almost cloudless. The fireball moved with moderate speed, varying in size and lustre as it fell, and its motion was directed to the north-north-west point of the horizon, but it disappeared when 21° in altitude. Its brilliancy was such that had it appeared at night the heavens would have been strikingly illuminated. The fireball was observed from other places, and it appears certain that it was moving from a radiant point near the star Capella. There is a well-known shower of brilliant meteors from this region in the month of February. It is hoped that further observations of the recent fireball will come to hand so that its height, velocity, and exact direction may be computed.

A PRINTING CHRONOGRAPH.—The printing chronograph was invented by Prof. G. W. Hough, of Dearborn Observatory, in 1885. It is briefly described by Prof. Sampson in the Monthly Notices, R.A.S., for April, 1903. Its use leads to a decided increase of accuracy in the recording of transits or other time observations as compared with older forms of chronograph. This becomes of particular importance now that the use of the recording micrometer has considerably reduced the errors in the signals sent from the telescope to the chronograph.

The Société Genevoise, 95 Queen Victoria Street, E.C.4, is now showing a new printing chronograph. There are three discs, marking minutes, seconds, and hundredths, which revolve in an hour, a minute, and a second respectively; the first has to be set by hand to agree with the clock; the adjustment of the others is effected automatically. When a signal is sent the discs are pressed momentarily against a typewriting ribbon, behind which is a paper tape; the tape is moved automatically after each signal; there is thus no waste of paper between the signals, and a night's record is comprised in moderate limits; this counterbalances the greater awkwardness of a tape record as compared with a cylindrical one for a long night's work. The discs are electrically driven by a motor the E.M.F. of which is 12 volts, supplied by secondary cells. The net weight of the installation is 66 lb., and gross weight 110 lb.

NOVA PUPPIS 1902.—The *Gazette Astronomique* for December last records the discovery of a new star by Miss Woods from the negatives taken at the Harvard Observatory. The position of the nova was R.A. 8h. 9m. 36·4s., decl. −26° 15·8′ (1900); the star was thus situated on the fringe of the Milky Way, the region in which novæ are usually found. The following is a summary of the facts recorded:—1901 (invisible), <16 mag.; 1902, September 24, <10·3 mag.; November 19, 7 mag.; December 6, 7 mag.; 1903, June 3, 10·5 mag.; and 1905, <14·5 mag. (invisible afterwards). More than 400 negatives of the region were examined. Judging from the facts recorded, it looks as if the nova reached its maximum some time before November 19, 1902, because it is not usual for new stars to maintain their maximum magnitude for such a long period as seventeen days. No photographs of the spectrum were taken.

fish (*Pterophyllium scalare*), the last two species new to the collections. The report of the secretary recorded a considerable decrease in the number of visitors to the gardens in January as compared with the numbers of the corresponding month last year.

At a meeting of the council of the National Institute of Agricultural Botany held on February 9 the first election of fellows of the institute took place. A hundred and ten candidates were elected, among whom were the following:—H.R.H. the Duke of York, the Prime Minister, the Duke of Bedford, the Marquess of Crewe, the Earl of Ancaster, the Earl of Derby, the Earl of Crawford, Viscount Milner, Lord Clinton, Lord Bledisloe, Lord Ernle, Sir Gilbert Greenall, Sir Harry Verney, Sir Matthew Wallace, the Hon. E. G. Strutt, the Right Hon. E. C. Pretyman, M.P., the Right Hon. Sir A. Griffith-Boscawen, Sir Thomas Middleton, Mr. Charles Adeane, Mr. Samuel Farmer, Mr. R. R. Robbins, and Lady Margaret Boscawen.

The officers and other members of council of the Malacological Society of London for the ensuing year were elected on February 10 as follows:—*President:* Mr. A. S. Kennard. *Vice-Presidents:* Mr. J. R. le B. Tomlin, Prof. A. E. Boycott, Mr. G. K. Gude, and Mr. C. Oldham. *Treasurer:* Mr. R. Bullen Newton. *Editor:* Mr. B. B. Woodward. *Secretary:* Mr. A. E. Salisbury. *Other Members of Council:* Dr. A. H. Cooke, Mr. H. O. N. Shaw, Lt.-Col. A. J. Peile, Mr. T. Iredale, Dr. E. W. Bowell, and Mr. Hugh Watson.

On Thursday next, March 2, Prof. H. M. Lefroy will deliver the first of two lectures at the Royal Institution on (1) "The Menace of the Insect Pest" and (2) "The Balance of Life in Relation to Insect Pest Control." On Saturday, March 4, Sir Ernest Rutherford will begin a course of six lectures on radioactivity. The Friday evening discourse on March 3 will be delivered by Dr. C. Morley Wenyon on "Microscopic Parasites and their Carriers."

Dr. W. Bateson, director of the John Innes Horticultural Institution, Mostyn Road, Merton, S.W.19, is giving a demonstration of the genetics of *Primula sinensis* at the institution to-day, February 23, at 3 p.m. All interested in the subject are invited, and in particular those who attended Dr. Bateson's lectures on genetics in November last. Admission is free, without ticket.

The ninth election to Beit fellowships for scientific research will take place in July next. Applications must be received by the Rector, Imperial College of Science and Technology, South Kensington, S.W.7, not later than April 19. Forms of application and all information respecting the fellowships are obtainable from the Rector of the Imperial College of Science and Technology upon written request.

The first award of the Meldola medal, referred to in Nature of January 12, p. 49, has been made by the council of the Institute of Chemistry, with the concurrence of Dr. Percy E. Spielmann, representing the Maccabæans, to Dr. Christopher Kelk Ingold.

Our Astronomical Column.

Detonating Fireball in Sunshine.—Mr. W. F. Denning writes that this object observed by him on February 7 at 3·55 p.m. appears to have been seen by comparatively few observers, although the loud detonations which followed it were heard by large numbers of people, chiefly in Warwickshire, over which county the fireball passed. It seems to have caused the loudest reports near the middle section of its flight, in the region of Quinton, Feckenham, Mere Hall, and Droitwich. At some places there was only one sound heard, at others two, but all the observers agree that the concussion and vibration were of startling intensity. The detonations were heard along a line directed from S.E. to N.W. The radiant point of the meteor was at 60°–11°, and the height from 56 to 32 miles; the length of luminous flight was 82 miles, and velocity about 10 miles per second. The position of the object was from over Oxfordshire to Shropshire.

Movements in Spiral Nebulæ.—In this column for January 12 reference was made to the movements in spiral nebulæ which Dr. Jeans described at the Royal Astronomical Society when exhibiting slides sent by Dr. van Maanen. Dr. van Maanen has now published the fifth paper on this subject in the issue of the *Astrophysical Journal* for December last, showing the results of his investigation with regard to the spiral nebula Messier 81. This paper contains the evidence on internal motions derived from the four nebulæ which Dr. van Maanen has now measured, namely, M 101, 33, 51, and 81, and he summarises the results in a table of which the following is an abstract. The second column gives the interval in years between pairs of photographs he has compared, and the following four columns the motions as indicated at the heads of the columns. The last column gives the number of nebular points the positions of which were independently measured:—

(*Units for Motions* 0·001″.)

Object	Interval in years	Rotational	Radial	Stream	Transverse	No. of nebular points
M 101	5	+21	+ 5	+21	0	87
M 101	9	+20	+ 6	+22	− 3	69
M 101	15	+12	+ 7	+14	+ 2	46
M 33	10	+20	+ 6	+24	− 2	30
M 33	5	+14	+12	+18	+ 4	21
M 51	11	+19	+ 8	+21	+ 3	79
M 81	6	+20	+17	+25	+16	52
M 81	11	+38	+13	+39	+ 7	104

It will be seen that all pairs of plates show the same type of motion, and, as Dr. van Maanen points out, the agreement in the values of the motion for each nebula derived from different pairs of plates is as satisfactory as could be expected. In addition to the rotational components, which correspond to the periods in the order of the nebulæ in the table, namely, 85,000, 160,000, 45,000 and 58,000 years, they all show a large outward radial component. The close agreement of the displacements in direction with the spiral arms of the nebulæ suggests, as he states, "a realisation of the motions described by Jeans in 'Problems of Cosmogony and Stellar Dynamics.'"

Our Astronomical Column.

SATURN.—This planet is now very favourably situated for telescopic study. The luminous rings are now only slightly inclined, as seen from the earth, and present but a small extent of surface and detail. The ball, however, with its various dusky bands and bright zones of different intensities, will furnish interesting features under high magnifying powers. Occasionally, white spots and other irregularities are to be seen in the belts, and markings of this kind are important and should be utilised for redetermining the rotation period. Mr. W. F. Denning points out that Saturn is akin to Jupiter in presenting a number of surface currents which differ considerably in their relative velocities. In 1903 a number of light and dark spots became visible in the north temperate region of the planet, and these indicated a rotation period of 10 hours 37 minutes and 52 seconds.

Saturn will be in opposition to the sun on March 25, and situated at a distance of 794 millions of miles from the earth.

METEORIC FIREBALLS.—A magnificent fireball is described as having passed over the southern hemisphere on January 11 last. Its flight was witnessed from the Liverpool liner *Vauban*, which arrived at New York on February 20. The fireball is described as being as large as the full moon and moving very slowly from 10 degrees above the western horizon to the eastern horizon. It occupied three and a half minutes in its flight and all the while emitted a blaze of light sufficiently powerful to illumine the sea and ship in an extraordinary degree.

On February 17, at 11·32, a brilliant meteor was observed from many places, including London, Barnet (Herts), Stowmarket, Droitwich, and Scunthorpe, Lincolnshire. As seen from places not remote from the object it appeared to be many times brighter than Venus, and its flight was fortunately witnessed by several observers who apply themselves to celestial studies, including Mr. A. King, Mr. J. P. M. Prentice, Mr. A. N. Brown, Mr. Gheury de Bray, and others. Computation shows that the meteor had a radiant at about 125° +13° in Cancer, and that its height was from 62 to 29 miles from over Yarmouth to Winchester, Hants. Its luminous course extended over 41 miles and its velocity was 14 miles per second. It is remarkable how many fireballs displaying exceptional characteristics have appeared during the period from February 7 to 22 in different years.

COMPARISON OF SPEED OF BLUE AND YELLOW LIGHT.—*Harvard College Observatory Bull.* No. 763 contains an investigation of the difference in the times of the phases of the short-period variables in the globular cluster Messier 5 in Libra, as determined from photographic plates sensitised for blue and yellow light respectively. On the average the times were later in the blue light by 35 seconds, with a probable error of 70 seconds. The distance of the cluster was found by five different methods to be about forty thousand light-years, making it follow the Hercules cluster, Messier 13, as the second in nearness of those north of the equator. Accepting this distance, the speeds of blue and yellow light in the intermediate space do not differ by more than one part in ten thousand million as a maximum possible. Since any absorbing medium would cause the speeds to differ, this affords an upper limit to its amount.

THE ILLUMINATION OF THE ECLIPSED MOON.—The *B.A.A. Journal* for January contains an important article by L. Richardson discussing the action of the terrestrial atmosphere in refracting sunlight on to the eclipsed moon. Tables and diagrams indicate the amount of refraction of light at various heights above the earth. The values at heights of 0 km., 10 km., 20 km., 30 km., are 68′, 22′, 5′, and 1′ respectively; thus to reach the centre of the shadow the sunlight has to pass fairly near the earth's surface, and high mountains or clouds would intercept a good deal of it; an irregularity in the outline of the shadow in the eclipse of 1888 was plausibly attributed to cloud in the Amazon basin, or else to the Andes. The strange distortion that the sun would undergo to an observer on the moon is described.

The author deduces from theory that the centre of the shadow should be slightly brighter than the surrounding regions, and finds some support in the observations of May 1920. He constructed a model lens of concave section in printers' roller composition, with an opaque disc in the middle; when this was placed over a source of light, the brilliant ring could be seen round the dark disc, also the increase of illumination near the centre of the shadow. The bluish or greenish fringe often seen in the outer parts of the shadow is explained by stating that the sunlight that has passed high above the earth's surface would be much less reddened than that which passed low down. It is also pointed out that the varying distance of the moon from the earth is an important factor in altering the illumination in different eclipses. When the moon is in apogee it is further from the earth's "black shadow," and gets more light. After allowing for these factors, and for the mountain ranges that lie along the earth's terminator, the illumination of the moon should afford a useful index of the clearness of the zone of atmosphere that lies near the terminator.

PARALLAXES AND PROPER MOTIONS.—Mr. Van Maanen deals with this subject in *Contributions from Mt. Wilson Observatory*. No. 204 contains two important investigations, the first being a set of parallax determinations of specimen objects of various types made with the 60-inch reflector. The terms to reduce to absolute parallax have been derived from comparison with the spectroscopic parallaxes of Adams, etc. The mean parallax of 11 planetary nebulæ is of the order of 0·01″, the mean absolute magnitude is 8·4, and the mean diameter 0·06 light-year. Two Cepheids give small parallaxes of the same order as those found by Shapley from the proper motions; T Cassiopeiae, a long-period variable, has the considerable parallax 0·027″; its absolute magnitude varies from 3·9 to 9·7; two stars, Boss 500 and RR Lyræ, are notable for their high velocities, each about 200 km./sec., their absolute magnitudes being near 0; the value 0·019″ found for Nova Aquilæ is nearly the same as the accepted value for Nova Persei, 1901, while Campbell's hydrogen-envelope star (type O) and Boss 3322 (type N) are assigned parallaxes of 0·005″ and −0·002″. The radial velocity of the double cluster in Perseus is found to be −40 km./sec. and its proper motion +0·003″ in R.A. and +0·003″ in Decl. These values are so small that it is impossible to pick out cluster stars with certainty unless they are bright enough to permit their radial velocity to be determined. Tables are given of the individual motions and magnitudes of over 1500 stars.

some of the results of this inquiry was included in the article on "The Migration of British Swallows" in NATURE of March 16.

THE Ministry of Agriculture announces that bees can now be examined for the presence of the Acarine Disease on payment of a fee of 2s. for each sample submitted. Live bees only must be sent, and about 30 specimens should be taken from off the combs and packed in a small cage or box provided with ventilation-holes. A piece of muslin should be fastened across the inside for the bees to cling to during transit. A supply of candy sufficient to last for a few days, or a lump of sugar moistened with water, should be wrapped in muslin and fastened firmly to the inside of the box. The latter should be addressed to the Ministry of Agriculture, 4 Whitehall Place, London, S.W.1, and the name of the sender should be written on the reverse side of the label, but crossed through to prevent an error in transit. The remittance should be sent under a separate covering letter with as much information as possible concerning the bees. Payment must be made by postal order or cheque.

ON March 22 at a meeting of the Institution of Aeronautical Engineers a paper was read by Mr. Manning on "Seaplane Design," and on March 31 Mr. H. P. Folland dealt with the subject of aircraft design generally. The programme of future fixtures includes papers by Captain Sayers on "Some Unsettled Problems of Aeroplane Design" and by Major Hume on "The Seaplane's Place in Aviation." Visits have been arranged to the works of the De Haviland Aircraft Company, Simms Motor Units Ltd., the National Physical Laboratory, the South Kensington Museum, and the Croydon Aerodrome. The secretary is Mr. L. Howard Flanders, 60 Chancery Lane, and the president, Col. J. T. C. Moore-Brabazon, M.P.

WE have received from Messrs. Baird and Tatlock, of Cross Street, Hatton Garden, a copy of their new (1922) catalogue of apparatus for use in physiological and other laboratories where similar apparatus is required. The worker will find it a very valuable and an almost complete list of the instruments at present available for teaching and research purposes. In the latter case, it frequently happens that new apparatus has to be designed and fitted up to solve new problems; but the list sent to us will be of much assistance in giving information of what is actually to be obtained for the purpose in view. We note that the collaboration of physiologists has been obtained in the selection of the material to be included and the presence of apparatus for physico-chemical measurements is to be welcomed. The instruments for convenient measurement of electrical conductivity and potential have been somewhat difficult to obtain in recent years in England. The prices on the whole appear to be reasonable.

Our Astronomical Column.

THE SHOWER OF LYRIDS.—These meteors may be expected to return on the night of April 21, and as the moon will be absent this year at the time of the maximum display, they should be well observed. The best hour at which to witness the event will probably be near midnight, for in the morning hours on April 22 the earth is likely to have passed through the denser part of the stream. The shower certainly lasts ten days, but it appears in its most active stage for a short period only. Of late years the meteors of this system have not been visible in striking abundance, and it is an unfortunate circumstance that its period of revolution is unknown. A brilliant exhibition of the meteors may occur in any year, and quite unexpectedly as in 1803 and 1851.

THE POSITION OF NEPTUNE'S EQUATOR.—It has long been known that the plane of the orbit of Neptune's satellite Triton is changing its position. The only probable cause is the oblateness of Neptune, and it follows that the orbit plane makes a considerable angle with the planet's equator. By plotting out the poles of the satellite's orbit at different epochs we get an arc of a small circle, the centre of which is the pole of Neptune's equator. The latest determination of the position of the latter pole is that made by Mr. Arthur Newton (*Pop. Ast.*, March 1922). Making use of 1500 observations of the satellite, made from 1864 to 1908, he gives R.A. 19 h. 17 m., N. Decl. 38°·3 as the northern end of Neptune's axis. The pole of the satellite's orbit describes a circle round this, of radius 14°·7, in 425 years. There is little doubt that Neptune's rotation is retrograde; this has been verified for Uranus by the spectroscope, the period of 10¾ h. being found at the same time. In the case of Uranus the equator evidently coincides with the orbit planes, since these are all practically coincident and no change in them has been detected.

DETERMINATION OF STAR MAGNITUDES BY A THERMOPILE.—J. Schilt has devised a new method of determining photographic star-magnitudes, which he describes in Bull. No. 10 of the Astr. Inst. of the Netherlands. The light and heat from a lamp are focussed by a lens on a small circle of the plate, which is somewhat larger than any of the star-images; these images are then moved in succession into the circle of light, and the amount of heat absorbed by the image is measured by the galvanometer of the thermopile. The process is rapid, the equilibrium temperature being attained in three seconds. The probable error, deduced by comparing the measures of two exposures on the same plate, is found to be 0·02 mag., whereas that from the method of diameter of image is 0·11 mag.

The most striking advantage of the new method is that it gets rid of practically all error due to variation in the shape of the image with varying distance from the centre of the plate. It also gets rid of the error that arises in the star diameters in plates taken with a refractor, due to the chromatic aberration which depends on the star's colour. In fact the method appears to give the integrated amount of darkening of the film independently of the size or shape of the image. This is verified by the application of the method to some of the polar plates taken with the 60-inch reflector at Mt. Wilson. The tables show that it gives good results up to a distance of 44 mm. from the centre of the plate, whereas Seares had found that the diameter method needed corrections of about half a magnitude at a distance of only 20 mm. The method would seem to have a large field of usefulness in the photometry of faint stars on reflector plates.

cerned the specimens are not so well displayed as when pinned and set, but, on the other hand, they are secure against damage, and the "thymo-plas" method should be valuable for teaching purposes when specimens must of necessity be handled frequently. Collections mounted in this manner can be stored in microscope slide cabinets with undivided trays. By way of advertisement it is stated that "thymo-plas" is "adopted by Prof. Lefroy as the standard method for use in the Entomological Department, Royal College of Science, London." The price of the outfit is 3*s*. and 6*s*. according to size.

Two catalogues of second-hand works of science, each of exceptional interest, have recently reached us, namely, Sotheran's Catalogue of Science and Technology, No. 3, and Heffer's Catalogue (No. 210) of Scientific Books and Publications of Learned Societies. In the former list many works from the libraries of the late Profs. Carey Foster, J. Perry, and P. Duhem are offered for sale. In the latter a prominent feature is sets of scientific journals. The catalogues are obtainable free of charge from their respective publishers—H. Sotheran and Co., 140 Strand, W.C.2, and W. Heffer and Sons, Ltd., Cambridge.

Our Astronomical Column.

THE APRIL METEORS, 1922.—Mr. W. F. Denning writes that what appears to have been the most brilliant and abundant shower of Lyrids observed during the present century was witnessed by Miss A. Grace Cook and Mr. J. P. M. Prentice, of Stowmarket, on the night following April 21. Miss Cook, watching the sky up to 13 hours G.M.T., observed 30 Lyrids, and a number of others must have escaped observation while the paths of the brighter meteors were being recorded. Eight of the meteors seen were brilliant, six of them being estimated as equivalent to, or surpassing, the lustre of Jupiter. The maximum of the display apparently occurred in the two hours preceding midnight; the meteors moved swiftly, leaving trails. The brightest object appeared at 11 h. 12 m. G.M.T., and it left a conspicuous streak which remained visible for twenty seconds. Mr. Prentice also watched the progress of the shower, and saw many brilliant meteors, though the sky was partly clouded at times.

At Bristol the sky was overcast during the whole night, and no meteors could be seen.

ECCENTRICITY OF DOUBLE-STAR ORBITS.—Prof. H. N. Russell shows (*Pop. Ast.*, March) that it is possible to deduce average eccentricities, by statistical methods, even in the case of those long-period systems in which only a very small portion of the orbit has been described. All that is necessary is to note the angle between the tangent and the radius-vector, and compare the observed distribution of angles with that resulting from different assumed values of eccentricity. From observations of 750 pairs he deduces a mean eccentricity slightly greater than 0·6, about the same as that given by stars the orbits of which have been determined. This is an important result from the cosmogonic point of view, as the orbits now considered must be very large, and the periods measured by millenniums.

PROGRESSIVE LATITUDE CHANGES.—The reported change of the latitude of the International Station at Ukiah, California, at the rate of a foot a year, recently attracted considerable notice. Prof. F. Schlesinger devotes an article to the subject in *Astr. Journ.*, 798. He notes that Cohn's proper motions (depending on the Auwers system) are used for the latitude stars at the International stations, and that they differ systematically from those of Boss. The following list shows the apparent annual change of latitude of the six stations—(1) using Cohn's system and (2) using Boss's: Mizusawa, Long. −141° (1), +0·0008″ (2), −0·0079″; Tschardjui, Long. −63° (1), +0·0110″ (2), +0·0023″; Carloforte, Long. −8° (1), +0·0053″ (2), −0·0034″; Gaithersburg, Long. +77° (1), +0·0103″ (2), +0·0016″; Cincinnati, Long. +84° (1), +0·0099″ (2), +0·0012″; Ukiah, Long. +123° (1), +0·0106″ (2), +0·0019″. It will be seen that the systematic northward shift resulting from Cohn's values vanishes when Boss's are used. If we ascribe the changes to a motion of the pole, the indicated motion is 5 inches per annum towards North America. We may, however, consider that at Mizusawa, which is in a volcanic region, there is an actual surface shift of 10 inches per annum southward; the shifts at the other stations are small enough to be regarded as accidental. Prof. Schlesinger urges that observations at the second, fourth, and fifth stations, which were dropped during the war, should be resumed, at least temporarily.

EFFECTIVE TEMPERATURES OF STARS.—Various methods used to obtain stellar temperatures give different results, yet it is interesting to note that the divergences are not great; indeed, for stars of classes G, K, and M, stars of comparatively low temperature, the agreement is fairly close. The cause of these disagreements lies probably in the fact that each observer has limited himself to a portion of the spectrum only, which may not necessarily contain the observed maximum spectral energy. Dr. W. W. Coblentz, in the Proceedings of the National Academy of Sciences (U.S.A.) (vol. 8, No. 3, p. 49), gives the results of his inquiry into the effective temperatures of 16 stars as estimated from the energy distribution in the complete spectrum.

By means of screens of red and yellow glass, quartz, and water he found it possible to obtain the radiation intensity in the spectrum in consecutive portions from 0·3μ to 10μ. In addition to an interesting table giving a comparison of the total radiation from stars having closely the same visual magnitude but of very different spectral class, Dr. Coblentz sums up his results in another table, comparing his stellar temperatures with values previously obtained by other workers. As the values he has deduced will prove very useful for reference they are here reproduced, commencing with the hottest stars and passing through the various stellar types, taking class Go as standard.

Star.	Spectrum Type.	Temp.
ϵ Orionis	Bo	13,000° K
β Orionis	B8p	10,000
α Lyræ	Ao	8,000
α Can. Maj.	Ao	8,000
α Cygni	A2	9,000
α Aquilæ	A5	8,000
α Can. Min.	F5	6,000
α Aurigæ	Go	6,000
α Bootis	Ko	4,000
β Geminorum	Ko	5,500
α Tauri	K5	3,500
α Orionis	Ma	3,000
α Scorpii	Ma p	3,000
β Androm.	Ma	4,000
μ Geminorum	Ma	3,500
β Pegasi	Mb	3,000

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MESSRS. DULAU AND CO., LTD., 34 Margaret Street, W.1, have just issued a catalogue (No. 93) of second-hand books in zoology offered for sale by them. Upwards of 3000 works are listed under the following headings: entomology and Arachnida; conchology and Mollusca; minor classes; general zoology; Mammalia, fishes, reptiles, etc.; ornithology and oology.

MESSRS. BERNARD QUARITCH, Ltd. (11 Grafton Street, W.1) have just issued a catalogue (No. 370) of important and rare second-hand books on natural history. Upwards of 2000 titles are listed under "General Works" and eleven classified divisions. Mr. F. Edwards (83 High Street, Marylebone, W.1) has just circulated Catalogue No. 431, which is largely devoted to publications of learned and scientific societies, and to works on the topography of the English counties.

Our Astronomical Column.

LARGE FIREBALL.—On May 21, at 12.32 G.M.T., a large meteor was observed by the well-known variable star observer, M. Felix de Roy, at Antwerp, Belgium. The object moved slowly among the stars of Leo, and left a tail of sparks like a rocket. Its path was from 169° +9° to 155° +18°. The same meteor was observed by Mr. J. P. M. Prentice, at Stowmarket, and he recorded the path from 203° +1½° to 179° +15½°. The duration was estimated at six seconds. Comparing the two observations the radiant point is indicated at 280° −33° in Sagittarius. The height of the object was from about 60 to 57 miles and the velocity 15 miles per second. The meteor passed over the region from the south-west of Surrey to south of Warwick.

It is possible that the object radiated from Scorpio at 250° −27°, and that its height was 60 to 42 miles, but the observations are not quite conclusive, and more data are required.

COMETS.—There is great difference of opinion as to the magnitude of Skjellerup's comet; Dr. Steavenson makes it mag. 9; other observers, mag. 12. The following approximate orbit has been deduced from observations at Heidelberg, Yerkes Obs., and Milan, on May 20, 21, 22.

T 1922, May 19, 22 G.M.T.
ω 1° 15′ 55″
Ω 207 56 17
i 21 19 4
log q 9·94569

EPHEMERIS FOR GREENWICH MIGNIGHT.

	R.A. h. m. s.	N. Decl.	log r.	log Δ.
June 2	9 38 28	36° 34′	9·9638	9·5856
6	10 18 28	40 58	9·9747	9·5680
10	11 4 53	44 39	9·9871	9·5592
14	11 57 13	47 5	0·0011	9·5600
18	12 51 8	48 2	0·0161	9·5695

The comet should be looked for as soon as the sky is dark; its path lies through Lynx (near Alpha on May 30), Leo Minor, and Ursa Major (near Mu on June 6, near Psi on June 10). Mr. G. Merton points out that the orbit closely resembles that of comet 1830 I; identity does not seem to be possible, but the two comets are probably portions of a primitive single comet.

The Annals of Tokyo Observatory, Tom. v., fasc. 5, contains an investigation of the perturbations of Wolf's periodic comet from 1884 to 1918, by M. Kamensky, Director of Vladivostock Naval Obs., who has revised the work of M. Thraen, finding several small corrections, which produce a marked improvement in the comparison with observation. Definitive elements are given for each return, the perturbations by all planets except Mercury, Uranus, and Neptune having been computed. M. Kamensky notes that there will be a close approach of the comet to Jupiter at the end of 1922; "it will experience such large perturbations that it is doubtful whether its seventh return to the sun—provided that it takes place—will be capable of being connected with the six preceding ones by a common system of elements." It is interesting to note that Brooks's periodic comet (1889 V) also makes a close approach to Jupiter this year, about the middle of June.

Lick Observatory Bull. No. 334 contains an investigation by H. M. Jeffers of the orbits of the two components of Taylor's comet, 1916 I, which was discovered at Capetown on November 24, 1915, as a small nebulosity 20″ in diameter, with an eccentric nucleus. On February 9, Barnard found the comet to be double, the two components being 10″ apart; the northern component was at first fainter, but afterwards became the brighter, and remained visible for two months after the southern one had disappeared; the following are the definitive elements found for the two components; perturbations by Venus, Earth, Mars, Jupiter, Saturn have been applied. They are for the equinox of 1916·0.

Epoch and Osc.	Northern Component. 1916, Jan. 21, 0 G.M.T.	Southern Component. 1916, Jan. 21, 0 G.M.T.
M	−1° 32′ 6″·4	−1° 32′ 4″·9
ω	354 47 57·7	354 47 21·8
Ω	113 54 10·2	113 54 25·1
i	15 31 40·6	15 31 27·8
ϕ	33 7 29·6	33 6 36·6
μ	557″·274	557″·695
log a	0·535959	0·535740

The linear distance between the components was least at perihelion, when it was 0·000047 astr. unit. Four months later it was 0·000168. It is noted that in the case of Biela's comet the distance was a maximum at perihelion. The elements show some resemblance to those of Daniel's comet of 1909, but identity is not possible. Taylor's comet is due at perihelion about June 13, 1922, but the conditions are unfavourable for observation; it may, however, be detected in the autumn.

The splitting of Taylor's comet does not appear to have been caused by Jupiter; the nearest approach in the revolution preceding 1916 was 1·1 unit, which is scarcely close enough to explain disruption.

THE following officers and members of council of the Röntgen Society have been elected for the session 1922–1923: *President*: Sir Humphry Rolleston; *Vice-Presidents*: Sir W. H. Bragg, Sir Ernest Rutherford, and Dr. A. E. Barclay; *Hon. Treasurer*: Mr. Pearce; *Hon. Secretaries*: Dr. E. A. Owen and Mr. R. J. Reynolds; *Hon. Editor*: Dr. G. W. C. Kaye; *Council*: Mr. C. Andrews, Dr. G. B. Batten, Mr. A. E. Dean, Mr. K. Edgcumbe, Mr. N. S. Finzi, Dr. F. L. Hopwood, Dr. F. H. Johnson, Mr. C. E. S. Phillips, Prof. A. W. Porter, Prof. A. O. Rankine, Sir Archibald D. Reid, and Dr. R. W. A. Salmond.

REFERRING to a paragraph in NATURE of June 10, p. 755, Dr. Marie C. Stopes writes:—"May I correct the impression your paragraph creates that the Clinic and the *Birth Control News* are activities of the Malthusian League, as this is not the case? The Society for Constructive Birth Control and Racial Progress, with which the clinic and news are associated, is a distinct society with a different basis. The policy of the Clinic and the *Birth Control News* is that of *constructive* and scientific control, as distinct from what is commonly understood as Malthusianism."

WE have received from Messrs. C. F. Elwell, Ltd. (Craven House, Kingsway) a handsomely produced catalogue relating to apparatus for wireless communication. A readable introduction deals with the immensity of the field of wireless telegraphy and the superiority of the continuous wave over the spark system of transmission. The most interesting portion is that dealing with the Elwell arc equipment on the Poulsen system, such as the company has supplied to several well-known long-distance stations, including Horsea, Eiffel Tower, Lyons, Rome, and the initial station of the Imperial Chain at Leafield. This apparatus is listed up to 700 amp. in the arc. Interesting details are also given of steel and wooden lattice aerial towers, ship receiving sets, and various accessories.

Our Astronomical Column.

THE METEORS OF PONS-WINNECKE'S COMET.—Mr. W. F. Denning writes that he regards it as highly probable there may occur a meteoric shower on about June 28. It will be a return of the display which he witnessed on June 28, 1916. If the meteors of this stream are connected with the comet of Pons-Winnecke, they will have a period approximating six years, and as the particles appear to be distributed abundantly along a lengthy section of the orbit, a repetition of the phenomenon of 1916 may be expected. It is true that the cometary meteors were not seen at many stations last year, although the conditions appeared promising, but in Japan a considerable number seem to have been recorded. In any event it is desirable carefully to watch the heavens, at the end of June, for further evidence of this interesting display. There will be no moonlight, and the radiant point in Quadrans or Draco will be favourably placed in the earlier hours of the night.

THE SEARCH FOR NEW STARS.—The period of the year is now approaching when the Milky Way will be very favourably placed for observation in northern latitudes, especially towards the end of June, and in July. The constellations Cygnus, Aquila, Ophiuchus, and Scorpio have been fruitful in Novæ in past years, and they offer the prospect of further discoveries. When the moon is not bright the sky in the regions indicated should be scanned carefully for new objects. The best time to conduct the work will be near midnight, when the summer twilight will not seriously interfere.

An observer who is not familiar with a large number of the naked-eye stars, should compare the heavens with a star atlas, and this method, often repeated, will soon enable him to dispense with the atlas. Certain new stars are very quick in their rise to brilliancy, and a vast difference in their magnitude often occurs in a few hours, so that it is really essential to repeat the search several times in the course of a night. Wherever the galaxy runs the observer's eyes should diligently pursue the quest, and other quarters of the sky should occasionally receive attention.

Though twelve new stars visible to the naked eye burst into view between 1848 and 1921, not one appears to have been recognised during the previous 158 years; but this was probably due, not so much to the dearth of such objects, as to the want of capable observers.

COLOURS OF BINARY STARS.—The giant and dwarf theory of star-development gave a solution to an astronomical enigma of long standing. This was the frequency with which the fainter component of a binary tends to blue, while the brighter component is red or orange. On the old view this implied that the component was of earlier type than the bright star, and hence had developed more slowly. Some suggested, as a way of escape, that the blue of these stars might possibly not correspond with that associated with spectral type A or B. It was, however, found possible to obtain spectrograms of some of these blue components, which did not indicate that they differed from other blue stars. As soon as the giant and dwarf theory was mooted, it became clear that for giant stars the blue stage was in fact later than the red or yellow one.

Mr. Peter Doig examines the question from this point of view in Mon. Not. R.A.S. of April, and finds that it gives much the same line of demarcation between the giant and dwarf binaries as that given by the absolute magnitudes, based on all available parallaxes, including the spectroscopic ones. He gives 33 pairs in which the stars are giants, and 75 in which both are dwarfs. The former list includes Polaris, Regulus, Antares, β Cygni, ξ Bootis, etc.; the latter includes Castor and α Centauri. Mr. Doig notes that in some cases of great difference of mass the companion might have become a dwarf of a redder type than the primary, while the latter was still a giant. He then ventures to extend the principle to give estimated parallaxes for some systems not on the list. For example, α Librae is given as a dwarf, with parallax 0·045″; the parallax of Praesepe is estimated as 0·010″. The paper makes an appeal for the substitution of other terms for "early" and "late" as applied to spectral types, which are misleading in the case of giants. Prof. Turner suggested the terms "hotter" and "cooler" as preferable.